Docket No.: MRE-0047 PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF APPEALS AND INTERFERENCES

In re Application of		:	
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Dong June KIM		:	
		:	
Application No.:	10/020,937	:	Group Art Unit: 3652
		:	
Confirm. No.: 2861		:	Examiner: P. Chin
		:	
Filed:	December 19, 2001	:	Customer No.: 34610
		:	

For: PARTS SUCTION HEAD OF SURFACE MOUNT DEVICE

TRANSMITTAL OF APPEAL BRIEF

U.S. Patent and Trademark Office
2011 South Clark Place
Customer Window, Mail Stop Appeal Brief-Patents
Crystal Plaza Two, Lobby, Room 1B03
Arlington, VA 22202

Sir:

Submitted herewith in triplicate is Appellant(s) Appeal Brief in support of the Notice of Appeal filed October 8, 2003. Enclosed is Check No.11424 for the Appeal Brief fee of $330.00.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 16-0607 and please credit any excess fees to such deposit account.

Respectfully submitted,
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APPEAL BRIEF

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Sir:

This Appeal Brief is submitted in support of the Notice of Appeal filed October 8, 2003.

REAL PARTY IN INTEREST

The party in interest is the assignee, MIRAE CORPORATION. The assignment document is recorded at Reel 12395 and Frame 0102.

RELATED APPEALS AND INTERFERENCES

There are no related appeals and interferences.

STATUS OF THE CLAIMS

This is an appeal from the final rejection dated April 9, 2003 of claims 1-14. No other claims are pending.

STATUS OF AMENDMENTS

One Amendment filed on January 21, 2003 has been entered. A correct copy of appealed claims 1-14, including all entered amendments thereto, appears in the attached Appendix.

SUMMARY OF THE INVENTION

The invention relates to a parts mounting machine which is used to mount electronic components on a printed circuit board. A parts mounting machine forms one part of an automated assembly line designed to automatically create completed printed circuit boards. Specifically, the invention relates to a parts mounting head of a parts mounting machine.

An automated printed circuit board assembly line will usually include at least a conveyer belt system, a solder paste deposition machine, a parts mounting machine, and a solder reflow oven. The conveyer belt will first move an unpopulated, empty, printed circuit board into the solder deposition machine. The solder deposition machine will deposit small dots of solder paste onto predetermined positions on a printed circuit board where the leads of electrical components are to be mounted. The conveyer belt will then move the printed circuit board with the deposited dots of solder paste to the parts mounting machine.

The conveyer belt moves the printed circuit board to a precise mounting position on the parts mounting machine, and the board is then usually clamped in place. A mounting head of the parts mounting machine then picks up individual electronic components from a parts supply device and mounts the electronic components at predetermined positions on the printed circuit board. This involves placing electronic components onto the board so that the leads of the components are placed in the dots of solder paste. Once all the electronic components have been mounted on the printed circuit board, the conveyer belt carries the printed circuit board to a solder reflow oven.

The printed circuit board is heated in the reflow oven to cause the solder paste to liquify. The printed circuit board is then cooled, causing the solder to solidify. Thus, the parts are permanently mounted on the printed circuit board, and the leads are electrically coupled to the conductive patterns formed on the printed circuit board.

The parts mounting head of the parts mounting machine is mounted on an "X-Y gantry," which is a device capable of moving in both the X and Y directions over the parts mounting position where the printed circuit board is located. The X-Y gantry is moved by motors, under the control of a central control system. The controller causes the X-Y gantry to move the mounting head first to a parts supply area where the mounting head picks up one or more electronic components, and then over a predetermined position on the printed circuit board where the electronic components are to be mounted.

The mounting head includes one or more suction nozzles, which are the devices that actually pick up the electronic components from a parts supplier and place them onto the

printed circuit board. The suction nozzles of the mounting head are moveable in the Z (up and down) direction. Thus, in a typical placement operation, the X-Y gantry will move the mounting head in the X and Y directions to position the mounting head over the parts supplier. A suction nozzle will then move downward in the Z direction, and the suction nozzle will pick up an electronic component. The pickup operation literally uses suction to suck an electronic component onto the tip of the suction nozzle. Suction (vacuum) continues to be applied to firmly hold the electronic component on the tip of the suction nozzle. The suction nozzle them moves upward in the Z direction.

The X-Y gantry then moves the mounting head over a predetermined position on the printed circuit board where the electronic component is to be mounted. The suction nozzle is moved downward in the Z direction to place the electronic component onto the printed circuit board. As mentioned above, the leads of the electronic component are placed into the dots of solder paste previously deposited onto the circuit board. The suction force is released, and the suction nozzle is moved upward in the Z direction, leaving the electronic component mounted on the printed circuit board.

Most mounting heads have a plurality of suction nozzles. Each of the suction nozzles is independently movable in the Z direction. In a typical mounting operation, the mounting head will move to a parts supply area and each of the suction nozzles will pick up their own electronic component. The mounting head will then move over the printed circuit board, and the suction nozzles will mount their respective electronic components onto the printed circuit board, one by one.

Also, when a suction nozzle picks up an electronic component, the precise orientation of the electronic component relative to the mounting head will not be known. For this reason, after an electronic component is picked up by a suction nozzle, the suction nozzle may move over a digital camera. The digital camera will take a quick photo of the leads of the electronic component. A processor then interprets the resulting image to determine the precise orientation of the electronic component. It is usually necessary to turn or rotate the suction nozzle and the held electronic component slightly to ensure that the leads are properly placed into the dots of solder paste on the circuit board during the placing operation.

Furthermore, because a single machine must be capable of picking up many different types of electronic components, the mounting head is configured so that multiple different types of suction nozzles can be used. Some suction nozzles are quite small and are used for very small electronic components such as individual transistors or capacitors. Other suction nozzles are larger and are designed to pick up large electronic components such as memory or processor chips. Each of the nozzles has a standard mounting base which can be inserted into a vacuum socket on the mounting head.

Figure 1 of the present application shows a portion of a typical mounting head of a parts mounting machine. The device includes a socket 32, into which a suction nozzle is mounted. The socket 32 is mounted in a moving block 34, which can move upward and downward in the Z direction along a linear motion guide 33. The socket 32 is also coupled to a ball spline 21. The socket 32 can be rotated by the ball spline to properly align an electronic component held by a nozzle mounted in the socket 32.

The ball spline 21 can move into and out of a ball spline nut 22, and a hollow shaft that extends upward from the ball spline nut 22. The ball spline nut 22 and the hollow shaft are coupled to a rotating shaft of a motor 10 by a coupling 1. The coupling 1 allows the ball spline nut 22, ball spline 21 and the moving block 34 and socket 32 to be disconnected from the motor 10.

The arrangement shown in Figure 1 allows a rotational force of the motor 10 to be transmitted to the nozzle socket 32 at the bottom of the mounting head. This means that the motor can be used to rotate a suction nozzle and an associated electronic component into the precise rotational position needed to mount the electronic component onto a printed circuit board. The ball spline retracts into the ball spline nut and the hollow shaft to allow the nozzle socket 32 and moving block 34 to move upward and downward in the Z direction so that a suction nozzle can pick up and place electronic components.

Because there are so many moving parts in this mounting head, it is necessary to perform regular preventative maintenance. The moving parts must be lubricated, and aligned. Also, it is often necessary to replace parts that wear out. In a prior art mounting head, like the one shown in Figure 1, the only way to remove the nozzle socket 32 and moving block 34 is to loosen the coupling 1 at the top of the assembly. Once the coupling is loosened, the entire assembly, including the ball spline 21, the ball spline nut 22 and the hollow shaft are all removed from the mounting head. Then, after a part has been replaced or after maintenance has been performed, the entire assembly must be re-mounted on the machine, and the coupling 1 re-tightened. It is necessary to carefully align the ball spline 21 and hollow shaft to ensure the

machine operates smoothly and does not bind during rotation and retraction of the ball spline.

Figure 5 shows a cross-sectional view of a portion of a mounting head embodying the present invention. In this embodiment, a first coupling 41 is used to attach the motor 10 to an upper end of the ball spline unit 20. A second coupling 42 is used to attach a lower end of the ball spline unit 20 to the moving block 34 and the socket 32. The use of the second coupling allows the moving block and its associated parts to be removed from the mounting head without the need for removal of the ball spline unit 20.

This arrangement makes it much easier to perform maintenance on the moving block and it's associated parts. First, the single coupling at the top of the ball spline unit is often difficult to reach on a prior art machine. When it is only necessary to perform maintenance on the moving block and its associated parts, the use of the second coupling on the bottom of the ball spline unit makes it much easier for maintenance personnel to remove and replace the moving block, as compared to the prior art machines.

The use of the second coupling also eliminates the need to re-align the ball spline and hollow shaft when maintenance is only performed on the moving block and its associated components. This also makes it easier for maintenance personnel and shortens the time required to perform the maintenance.

Furthermore, in a mounting head embodying the present invention, it is possible to mount the hollow shaft of the ball spline unit 20 in a bearing 23. The bearing 23 helps to preserve the proper alignment of the ball spine unit, which improves the overall precision of the machine in mounting electronic components.

In prior art mounting heads, mounting the hollow shaft of the ball spline unit in a bearing was impractical because the entire ball spline unit had to be frequently removed from the machine during maintenance operations. If the ball spline unit were mounted in a bearing, additional time and work would be required to remove the ball spline unit and the attached moving block. Thus, the bearing was omitted.

In contrast, in a mounting head embodying the present invention, which utilizes the second coupling, the moving block 34 and its associated components can be removed for maintenance without disturbing the ball spline unit 20. Because the ball spline unit does not require frequent maintenance, the use of the bearing 23 becomes practical.

For all the above reasons, the use of the second coupling 42 and the bearing 23 provides many advantages over a prior art mounting head where only a single coupling is used, and where the ball spline unit must be removed with the moving block.

ISSUES

1. Whether the Examiner has established a *prima facie* case under 35 U.S.C. §103(a) that claims 1-4, 6, 7, 10 and 12-14 are obvious over the Admitted Prior Art of Figure 1 (hereinafter, "APA").

2. Whether the Examiner has established a *prima facie* case under 35 U.S.C. §103(a) that claims 5, 8, 9 and 11 are obvious over the APA, in view of U.S. Patent No. 6,308,402 to Hwang (hereinafter, "Hwang").

GROUPING OF THE CLAIMS

Appealed claims 1-4 form a single group and stand or fall together. Claim 1 is the only independent claim of this group.

Appealed claim 5 depends from independent claim 1 and forms a separate group that is allowable for additional reasons.

Appealed claims 6, 7, 10 and 12-14 form a separate group and stand or fall together. Claim 6 is the only independent claim of this group.

Appealed claims 8, 9 and 11 all ultimately depend from independent claim 6 and form a separate group that stands or falls together.

THE ARGUMENT

I. Claims 1-4 Are Allowable

Claim 1 recites a parts suction head of a surface mount device that includes a motor configured for generating a rotary force and transmitting the rotary force to a rotation central axis, a ball spline unit, a rotation shaft unit, and a plurality of couplings. Claim 1 recites that the plurality of couplings are for transmitting a rotary force of the rotation central axis to the ball spline unit, and for transmitting a rotary force of the ball spline unit to the rotation shaft unit.

As explained above, the APA lacks a coupling that is configured to transmit a rotary force of the ball spline unit to the rotation shaft unit. In the APA devices, only a single coupling is used, and the single coupling is used to transmit a rotary force of the rotation central axis to the ball spline unit. As a result, the APA devices have all the drawbacks explained above.

The Examiner has asserted that it would have been obvious to one of ordinary skill in the art, at the time of the invention, to add a second coupling to the APA device, wherein the second coupling acts to transmit a rotary force of the ball spline unit to the rotation shaft unit. The Examiner has not provided any prior art references that show such a configuration. Nor has the Examiner pointed to any similar devices which would lead one of ordinary skill in the art to add a second coupling to the APA device. Because the Examiner has been unable to produce any prior art references that show, teach or even suggest adding a second coupling to the APA device, it is respectfully submitted that it requires the improper use of hindsight, in view of Applicant's own invention, to find a motivation to add the claimed second coupling to the APA device. For at least this reason, it is respectfully submitted that the rejection is

improper and should be withdrawn.

II. Claim 5 Is Allowable

Claim 5 depends from claim 1 and further recites a bearing fixed to the ball spline nut and configured to restrict a rotation radius of the rotation shaft unit. As explained above, the addition of such a bearing adds to the precision of the machine.

The APA devices lack the claimed bearing. The APA device lacks such a bearing because the use of such a bearing impedes maintenance personnel attempting to perform maintenance on the APA device.

The Examiner has asserted that one of ordinary skill in the art, viewing the APA device and Hwang would have found it obvious to: (1) add the claimed coupling between the ball spline unit and the rotation shaft unit; and (2) add the claimed bearing. For at least the reasons above, it respectfully submitted that it requires the impermissible use of hindsight to add the claimed coupling between the ball spline unit and the rotation shaft unit. For at least this reason, it is respectfully submitted that claim 5 is allowable.

In addition, Applicant notes that the structure of the mounting head disclosed in Hwang is quite different from the structure of the mounting head shown in the APA. In the Hwang structure a first mechanism moves the suction nozzle assembly upward and downward, and a second completely different assembly causes the suction nozzle to rotate.

Specifically, in the Hwang mounting head a voice coil motor 14 and linear position transformer 17 act to move the suction nozzles upward and downward. But the suction nozzles

41 are offset from the mechanism that moves the nozzles up and down. The suction nozzle 41 is mounted on and attached to a separate spindle unit 40. A pinion gear 16 is mounted on the outer surface of the spindle unit 40. The pinion gear interacts with a rack 15, which move in a linear direction. Movement of the rack causes the pinion gear, the spindle unit and the nozzle to rotate.

The Examiner asserts that because the Hwang device includes various bearings (the Examiner never identifies a particular bearing) it would have been obvious to add the claimed bearing fixed to the ball spline nut. It is respectfully submitted that such a combination would not have been obvious.

Because of the great differences between the structure shown in Hwang and the structure shown in the APA, one of ordinary skill in the art would not have had any motivation to add one of the bearings from the Hwang device to the APA device. More importantly, even if one of ordinary skill in the art had considered adding such a bearing, he or she would have chosen not to add a bearing to the APA device for all the reasons explained above. Specifically, adding the bearing would make it more difficult for maintenance personnel to remove the moving block and the attached ball spline assembly from the mounting head in order to perform maintenance. For these additional reasons, it is respectfully submitted that the combination is improper and the rejection should be withdraw.

III. Claims 6, 7, 10 and 12-14 Are Allowable

Claim 6 is directed to a parts suction head that includes a rotation unit, a ball spline unit, a rotation shaft, and first and second couplings. Claim 6 recites that the first coupling

rotationally couples the rotation unit to a first end of the ball spline unit. Claim 6 also recites that the second coupling rotationally couples a second end of the ball spline unit to the rotation shaft.

The Examiner admits that the APA fails to disclose or suggest the claimed second coupling. However, the Examiner asserts that one of ordinary skill in the art, at the time of the invention, would have found it obvious to add a second coupling to the APA device.

For all the reasons given above in connection with claims 1-4, it is respectfully submitted that it requires the improper use of hindsight, in view of Applicant's own invention, to find a motivation to add the claimed second coupling to the APA device. For at least this reason, it is respectfully submitted that the rejection is improper and should be withdrawn.

IV. Claims 8, 9 and 11 Are Allowable

Claims 8, 9 and 11 all ultimately depend from claim 6. These claims further recite a bearing mounted on the ball spline unit and configured to hold the ball spline unit in a fixed position, but to allow the ball spline unit to rotate.

The Examiner has asserted that one of ordinary skill in the art, viewing the APA device and Hwang would have found it obvious to: (1) add the claimed second coupling between the ball spline unit and the rotation shaft; and (2) add the claimed bearing. For at least the reasons given above, it respectfully submitted that it requires the impermissible use of hindsight to add the claimed coupling between the ball spline unit and the rotation shaft. For at least this reason, it is respectfully submitted that claims 8, 9 and 11 are allowable.

In addition, for the same reasons given above in connection with claim 5, it is respectfully submitted that one of ordinary skill in the art would not have found any motivation to add one of the bearing of the Hwang device to the APA device due to the differences between the devices. Furthermore, even if one of ordinary skill in the art had considered importing a bearing from the Hwang device into the APA device, he or she would have chosen not to add a bearing because doing so would unnecessarily complicate the maintenance procedures. For these additional reasons it is respectfully submitted that the combination is improper and should be withdrawn.

CONCLUSION

In view of the foregoing, it is respectfully submitted that the Examiner has failed to establish a *prima facie* case under 35 U.S.C. §103(a) that claims 1-4, 6, 7, 10 and 12-14 are obvious over the APA. It is also respectfully submitted that the Examiner has failed to establish a *prima facie* case under 35 U.S.C. §103(a) that claims 5, 8, 9 and 11 are obvious over the APA, in view of Hwang. For these reasons, withdrawal of the rejections and further action on the merits is respectfully requested.

Respectfully submitted,
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APPENDIX

1. (Amended) A parts suction head of a surface mount device, comprising:

a motor configured for generating a rotary force and transmitting the rotatory force to a rotation central axis;

a ball spline unit configured for performing a rotation movement and a vertical reciprocation movement by the rotary force generated from the motor;

a rotation shaft unit comprising a rotation shaft, wherein the rotation shaft unit is configured to be moved in a vertical direction and rotated for sucking or mounting parts; and

a plurality of couplings configured for transmitting the rotary force of the rotation central axis to the ball spline unit and for transmitting a rotary force of the ball spline unit to the rotation shaft unit.

2. (Amended) The parts suction head of claim 1, wherein the plurality of couplings comprise:

a first coupling configured for connecting the rotation central axis of the motor to a first end portion of the ball spline unit; and

a second coupling configured for connecting a second end portion of the ball spline unit to the rotation shaft unit.

3. (Amended) The parts suction head of claim 2, wherein a first end portion of

the ball spline unit comprises a ball spline nut and the first coupling is connected between the rotation central axis of the motor and the ball spline nut to maintain a predetermined distance m between the rotation central axis and the ball spline nut.

4. (Amended) The parts suction head of claim 2, wherein the second coupling is configured to maintain a predetermined distance m between the second end of the ball spline unit and the rotation shaft unit.

5. (Amended) The parts suction head of claim 1, further comprising a bearing fixed to the ball spline nut and configured to restrict a rotation radius of the rotation shaft unit.

6. A parts suction head, comprising:

a rotation unit;

a ball spline unit;

a first coupling that rotationally couples the rotation unit to a first end of the ball spline unit;

a rotation shaft configured to rotate and to move vertically in a reciprocal fashion; and

a second coupling that rotationally couples a second end of the ball spline unit to the rotation shaft.

7. The parts suction head of claim 6, wherein the rotation unit comprises a motor.

8. The parts suction head of claim 6, further comprising a bearing mounted on the ball spline unit and configured to hold the ball spline unit in a fixed position, but to allow the ball spline unit to rotate.

9. The parts suction head of claim 8, wherein the bearing is configured to align a rotational axis of the rotator unit with a rotational axis of the ball spline unit.

10. The parts suction head of claim 6, wherein the first end of the ball spline unit comprises a ball spline nut, and the second end of the ball spline unit comprises a splined shaft.

11. The parts suction head of claim 10, further comprising a bearing mounted on the ball spline nut and configured to hold the ball spline nut in a fixed position, but to allow the ball spline nut to rotate.

12. The parts suction head of claim 6, wherein the first coupling is configured to separate a lower end of the rotation unit from an upper end of the ball spline unit by a prescribed distance.

13. The parts suction head of claim 6, wherein the second coupling is configured to separate a lower end of the ball spline unit from an upper end of the rotation shaft by a prescribed distance.

14. The parts suction head of claim 6, wherein the second coupling is configured to allow the rotation shaft to be detached from the ball spline unit.